

PHYSICS 411-0 CLASSICAL MECHANICS

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Course Webpage: http://www.hep.anl.gov/ian/teaching/CM/CM_Winter10.html*ASSIGNMENT #3*Due at 2 PM, February 1st**Reading Assignments:**

Chapter 3 of Goldstein's book.

Problem 1

- (a) Consider a 1-body problem with a central potential $U(r) = kr$. Write down the equation of motion in the radial direction in terms of L the angular momentum of the system.
- (b) Use (a) to find the conditions on the initial velocities \dot{r} and $\dot{\theta}$ in order to have a circular orbit of radius r_0 .
- (Hint: a circular orbit exists if the equation of motion admits a solution with $\ddot{r} = 0$.)
- (c) By considering a small perturbation around the circular orbit, determine whether or not the motion is stable. If it is stable, find the oscillation frequency.

Problem 2

- (a) Solve for the potential energy V , the kinetic energy K , and the total energy E of a circular orbit with radius R in the Newtonian potential explicitly. Show that the virial theorem is satisfied:

$$E = \frac{1}{2}V = -K .$$

- (b) Use the virial theorem in (a) to resolve the following satellite paradox:
The effect of the slight atmospheric drag on a satellite in a circular orbit at a height of several hundred kilometers above the earth is to increase the speed of the stellite.

Problem 3

Problem 3.14 in Goldstein's.

Problem 4

Problem 3.19 in Goldstein's.

Problem 5

Problem 3.28 in Goldstein's.